The Impact of Real Estate on the Mixed-Asset Portfolio in Periods of Financial Stress

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Abstract

The case for holding real estate in the mixed-asset portfolio is typically made on its stabilising effect as a result of its diversification benefits. However, portfolio diversification often fails when it is most needed, i.e. during periods of financial stress. In these periods, the variability of returns for most asset classes increases thus reducing the stabilising effect of a diversified portfolio. This paper applies the approach of Chow et al (1999) to the US domestic mixed-asset portfolio to establish whether real estate, represented by REITs, is especially useful in times of financial stress. To this end monthly returns data on five assets classes: large cap stocks, small cap stocks, long dated government bonds, cash (T-Bills) and real estate (REITs) are evaluated over the period January 1972 to December 2001. The results indicate that the inclusion of REITs in the mixed-asset portfolio can lead to increases or decreases in returns depending on the asset class replaced and whether the period is one of calm or stress. However, the inclusion of REITs invariably leads to reductions in portfolio risk that are greater than any loss in return, especially in periods of financial stress. In other words, REITs acts as a stabilising force on the mixed-asset portfolio when it is most needed, i.e. in periods of financial stress.

Keywords: *Mixed-asset portfolios, REITS, financial stress*

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Introduction

Several studies have examined the diversification benefits of including public real estate (REITs) in the mixed-asset portfolio (Kuhle, 1987, Muller at al, 1994, Liang and McIntosh, 1998, Glascock et al 2000, and NAREIT, 2002). Nonetheless, there is no consensus as yet as to whether REITs should be included in the mixed-asset portfolio. In examining this issue previous studies have used data over a long period to determine the allocation to real estate. However, a long period of time provides only average estimates of the portfolio parameters from many types of economic conditions. Thus, the previous studies have essentially assumed that the risk and return characteristics of the various assets are the same during periods of financial stress and calm. Yet history shows that during periods of financial stress the risk of most asset classes increases, thus reducing the stabilising effect of a diversified portfolio. In other words, portfolio diversification often fails when it is most needed. Thus, traditional methods of portfolio analysis that fail to take account of the differences in market conditions will produce results that are at odds with investor expectations.

A number of studies have examined the optimal composition of the mixed-asset portfolio in different time periods and all conclude that assets show different returns over time and so a single portfolio allocation strategy may not be optimal (see Farrell, 1989, Marmer, 1991, Benari, 1990 and Clarke and de Silva, 1998 among others). Thus, all the studies advocate switching the composition of the portfolio to take account of the type of market conditions expected. These studies typically define market conditions with reference to the economic and/or business cycle. Chow et al (1999), however, takes a different approach and uses a multivariate technique to determine which period of a return series can be classified as "unusual". In their study, just over one-quarter of the months were categorised as unusual for one reason or another. These unusual months are refereed to as periods of turmoil or financial stress. The remaining three-quarters of the return series are referred to as periods of non-stress, or calm. Once these periods are identified Chow et al (1999) develop covariance matrices for the periods of stress and calm to calculate the mean-variance portfolio parameters. Chow et al (1999) arguing that the covariance matrix of the outlier data is a better description of the risk of the mixed-asset portfolio during periods of financial stress than the covariance matrix from the full sample of observation. Then using the data from 12 returns series the authors find that the volatility and correlations estimated from outliers differ significantly from those based on the overall data. Thus, the optimal portfolio based on the outlier data produced a much more conservative portfolio mix than the full-sample data with concomitantly lower returns. The optimal mix in the stress period suggesting a 76 percent weight in bonds and cash, 12 percent in commodities and only 12 percent in equities. In contrast, the optimal holdings based on the full sample suggested a 41 percent holding in equities, only 56 percent in bonds, 3 percent in commodities and no holding in cash. Hence, the volatility of the optimal portfolio estimated from the outlier data was nearly twice that of the full-sample data. However, Chow et al (1999) did not include real estate in their analysis, even though real estate is often characterised as a stabilising force within the mixed-asset portfolio due to its diversification benefits.

Consequently, this paper applies the approach of Chow et al (1999) to the US domestic mixed-asset portfolio to establish whether real estate is particularly useful in periods of financial stress. To this end monthly returns data of a five assets classes: large cap stocks, small cap stocks, long-dated government bonds, T-bills and public real estate (REITs) is analysed over the period January 1972 to December 2001. The result indicating that the inclusion of REITs in the mixed-asset portfolio can lead to increases or decreases in average returns depending on the asset class replaced and whether the period in one of calm or stress. However, the inclusion of REITs invariably leads to reductions in risk that are greater than any loss in return, especially in periods of financial stress.

The remainder of the paper is organised as follows. The next section describes the research design used in this study. Section 3 describes the data and classifies the return series into periods of calm and stress using the methodology of Chow et al. (1999). Section 4 provides the initial results of the impact of REITs on the mixed-asset portfolio assuming a base-line portfolio containing 60% in equities and 40% in bonds. We then stress test these results by constructing two new base-line portfolios: one based on the assumption that all periods are periods of calm and the other based on the assumption that all periods were ones of financial stress. In this way the consequences of holdings in REITs on portfolio performance can be evaluated when the investor are holding the wrong asset mix. Section 6 contains concluding remarks.

Research Design

Two studies have examined the stabilising effect of real estate in the mixed-asset portfolio in periods of economic difficulties, Nelson (2002) and Sa-Aadu et al (2001). Nelson (2002) tests the proposition as to whether the inclusion of moderate amounts of real estate, defined as either 5% or 10%, acts as a stabilising force in the mixed-asset portfolio. Using quarterly data for the private real estate market, as measured by the NCREIF, index the author finds that real estate provides addition stability during extreme bull stock market conditions to an existing base-line portfolio of stocks, bonds and cash. A result supported when using monthly data for the public real estate market, as measured by the NAREIT index. However, in extreme bear market conditions only the private real estate market provided additional stability, whereas holdings in public real estate made the position worse. The approach of Nelson (2002) can be criticised on at least two counts. First, the author only uses periods of market stress as defined by extreme movements in the US Stock Market. In contrast, the approach of Chow et al (1999) examines all the return series, not just the returns on stocks, to find those periods that are extreme in one-way or another. Secondly, Nelson (2002) only considered six bull and bear market periods, whereas we consider a large number of periods (76) that are categorised as times of financial stress. The results here, therefore, provide a stronger test of the benefits of REITs in the mixed-asset portfolio.

Sa-Aadu et al (2001) tested the diversification benefits of including REITs into an existing optimal mixed-asset portfolio to see if real estate offers improved risk-adjusted performance when it is most needed, i.e. during downturns in the economic cycle. Using the volatile bounds methodology of Hansen and Jagannathan (1991) the authors conclude that real estate, as measured by the NAREIT index, offers addition risk/return benefits above that of small-cap stocks and bonds in the mixed-asset portfolio, especially during downturns in the economic cycle. The approach of Sa-

Aadu et al (2001) can be criticised on at least two counts. First, Sa-Aadu et al (2001) start with a portfolio comprising optimal allocations in a number of equity stocks, commodities and precious metals. Yet as is well known optimisation typically produces solutions with extreme holdings, with some assets taking zero weights while others have very large allocations. Black and Litterman (1992) refer to these as corner solutions. Thus, although the resulting portfolios are optimal in the statistical sense, the results would be unacceptable to any prudent portfolio manager and are unlikely to be held in practice (Jorion 1985). Secondly, under the Sa-Aadu et al (2001) approach the addition of REITs to the existing mixed-asset portfolio may offer no improvement in risk-adjusted performance. As a consequence, in various periods, the model would indicate a zero holding in real estate. Thus, any negative impact of the inclusion of real estate on the existing mixed-asset portfolio is excluded from the analysis. Yet, investors need to be aware of the advantages and disadvantages of holding in real estate in the mixed-asset portfolio.

This paper performs a similar analysis as Nelson (2001) and Sa-Aadu et al (2001) to evaluate the impact of REITs on the mixed-asset portfolio but takes a somewhat different approach. First, like Nelson (2002) we construct a base-line portfolio of equities and bonds with weights that are likely to be more representative of actual institutional holdings. However, unlike Sa-Aadu et al (2001) this may not be an optimal portfolio. To this base-line portfolio a percentage holding in REITs of between 5% and 20% in 5% increments was added, with REITs replacing one asset at a time. The risk/return performance of these expanded portfolios were then compared with the base-line portfolio. In this way the impact of real estate on the mixed-asset portfolio could be evaluated under a number of scenarios. Under the approach of Sa-Aadu et al (2001), however, the holdings in REITs is allowed to replace any of the asset classes. Thus, the impact of REITs on the mixed-asset portfolio is likely to be overstated, as real estate always replaces the worst performing asset at that particular time. The approach here, however, allows us to judge the impact of REITs under more realistic conditions. Secondly, unlike Nelson (2002) we consider a large number of periods of financial stress as defined by the approach of Chow et al (1999), rather than simply the six largest changes in the value of stocks. Third, unlike Sa-Aadu et al (2001) the asset weights of the mixed-asset portfolio are maintained throughout the period of analysis for at least three reasons. First, the strategic asset allocation (SAA) of an institutional portfolio is made with reference to the organisation's risk tolerance and long-term financial goals, which that are not subject to wild fluctuations over time. Secondly, although fund managers may be given discretion to deviate from the SAA weights to take advantage of any short-term tactical consideration, such deviations are usually set within tight limits (Harrison, 1992). Finally, the weight assigned to REITs, in the Sa-Aadu et al (2001) approach, could have a large variation over time in the expanded portfolio. However, the wholesale switching of holdings across the different asset classes, leading to a zero holding in a particular asset class in one period, or an extremely high holding in another, is unlikely to be representative of actual investor experience. In other words, the advantages and disadvantages of holding REITs in the mixed-asset portfolio examined here is based on more realistic portfolio holdings, in periods of clam and stress and with a specific allocation to real estate.

Data

The data used in this study are the monthly returns of the five asset classes: large cap stocks, small cap stocks, long dated government bonds, cash (T-Bills) and real estate over the period January 1972 to December 2001. All the data, apart from that for real estate comes from Ibbotson Associates (2002). The returns of real estate are measured by the NAREIT index. There are at least four reasons for measuring the performance of real estate by the returns of publicly traded REITs rather than returns from the private market. First, the returns of REIT as measured by the NAREIT index is monthly data and available over a considerable period of time. In contrast, the data from the private market, as measured by the NCREIF index, is quarterly and only available from 1978. Second, Nelson (2002) used the NAREIT index and found it made the performance of a portfolio worse in the market down turn. However, Nelson (2002) only used six periods of extreme conditions in the Stock Market to test the effectiveness of REITs in stabilising an existing mixed-asset portfolio. This study uses 76 periods of financial turmoil and so provides a stronger test of the impact of REITs on the mixed-asset portfolio. Third, using NAREIT data avoids the problem of appraisal smoothing in returns of the private real estate market and the issue of how to de-smooth the series (Geltner, 1993). Fourth, NAREIT (2002) have shown that adding REITs to a mixed-asset portfolio, over the period 1972 to 2000 would have offered considerable benefits in terms of portfolio performance. However, the data was not differentiated into periods of financial stress and calm and so provides only average results. The results here, therefore, provide a stronger test of the benefits of REITs in the mixed-asset portfolio.

Chow et al (1999) show that a period of calm or stress can be identified by use of the following distance statistic:

$$d_t = (y_t - \mu)\Sigma^{-1}(y_t - \mu)' \qquad (1)$$

where:

d_t = vector distance from the multivariate average
y_t = the return series
μ = mean return vector of return series y_t
Σ = covariance matrix of return series y_t

For the general n-return series case, d_t is distributed as a chi-square distribution with n degrees of freedom. Under this assumption, if an outlier is defined as falling beyond the outer 25 percent of the distribution and we have five return series, our tolerance boundary is a Chi-square value of 6.626. Thus, using equation 1 we calculate the chi-square score for each return vector in our series and if the observed score at time t is greater than 6.626, that vector of returns is classified as an outlier. Using this approach on the 360 monthly returns 76 months (21 percent) of the data series were classified as periods of financial stress and 284 (79 percent) of the data series was classified as periods of calm. Table 1 presents the summary statistics of the return series overall, while Table 2 shows the summary statistics for the periods of financial stress and calm.

Table 1: Summary Statistics Overall

Statistics	LARGE	SMALL	GOV	T-BILL	REITs
Mean	0.962	1.158	0.711	0.537	0.751
Std. Dev.	4.874	6.319	2.958	0.223	4.417
Correlation	LARGE	SMALL	GOV	T-BILL	REITs
LARGE	1.000				
SMALL	0.719	1.000			
LGOV	0.287	0.137	1.000		
TBILL	-0.057	-0.070	0.053	1.000	
ALLR	0.555	0.652	0.263	-0.042	1.000

Table 1 shows that small cap stocks offered the highest returns over this period 1.158% per month, but at a cost of the highest risk 6.319% per month (coefficient of variation 5.45). In contrast, T-Bills achieved a return less than half that of small cap stocks at 0.537% per month, but with a risk of only 0.223% per month (coefficient of variation 0.42). REITs showing a return just above that of long-term government bonds (0.75% per month), however, with a risk 30% higher 4.417% per month compared with 2.958%. The correlation matrix shows that large cap and small cap stocks show the largest positive relationship (ρ = 0.709), while small cap stocks and T-bills show the biggest negative association (ρ = -0.015), with REITs showing a positive relationship with both equities and bonds indicative of the hybrid nature of real estate investment.

Table 2: Summary Statistics for Periods of Financial Stress and Calm

Calm	LARGE	SMALL	GOV	T-BILL	REITs
Mean	1.254	1.324	0.689	0.500	0.909
Std. Dev.	3.362	4.557	2.290	0.170	3.125
Correlation					
LARGE	1.000				
SMALL	0.709	1.000			
LGOV	0.400	0.191	1.000		
TBILL	-0.013	-0.015	0.061	1.000	
RE	0.482	0.605	0.315	0.016	1.000
Stress	LARGE	SMALL	GOV	T-BILL	REITs
Mean	-0.129	0.538	0.795	0.675	0.164
Std. Dev.	8.338	10.596	4.700	0.323	7.490
Correlation					
LARGE	1.000				
SMALL	0.726	1.000			
LGOV	0.211	0.095	1.000		
TBILL	-0.027	-0.093	0.041	1.000	
RE	0.596	0.681	0.227	-0.052	1.000

Table 2 shows the performance of the five asset classes in the periods of stress and calm as derived by the Chow et al (1999) multivariate procedure. Panel A of Table 2 presents the summary statistics for the various assets classes during the periods of calm. Panel B of Table 2 shows the summary statistics for the periods of financial stress. Panels A and B show that, as expected, the portfolio parameters are significantly different in the stress periods than in periods of calm. The average returns of large cap stocks, small cap stocks and REITs are all considerably lower by 110%, 59% and 82%, in periods of stress compared with the results in calm periods. In contrast, the returns of government bonds and T-bills are 15% and 35% higher in the stress rather than the calm periods. In terms of risk the picture is much more even. The asset classes all showing large increases in risk, from a low of 90% for T-Bills to a high 148% for large cap stocks. The correlation matrix, however, shows an unexpected result. The average correlation of the correlation matrix in the stress

periods is 0.245 compared with 0.275 for the correlation matrix in the calm periods. In other words, the average correlation is less for the periods of stress than that for the period of calm! This would seem to suggest that there is likely to be very little difference in the portfolio composition in the calm and stress periods. This is unlikely to be the case for two reasons. First, the average values hide a number of large changes. Secondly, it is the covariance matrix and not the correlation matrix that is used in the portfolio optimisation problem. The covariance between any two investments is the product of the correlation coefficient and the individual standard deviations. As shown in Table 2 the individual risk significantly increases in the stress periods compared with calm periods. Hence the optimal portfolio composition in periods of calm and stress are likely to be very different.

The difference between the portfolio parameters can be investigated by a number of statistical tests. To test the equality of the covariance and correlation matrices we use the Box M test; which Box notes is distributed asymptotically as a Chi-square with ½(k-1)p(p-1) degrees of freedom, where k is the number of covariance to be tested and p is the number of assets in the covariance/correlation matrix (Box, 1949). Pearson (1969) has shown that the Chi-squared approximation is only appropriate for small dimensional problems and that for larger dimensional problems the test statistic follows an approximate F-distribution with f_1 and f_2 degrees of freedom[1]. Pearson (1969) has shown that the F approximation is more accurate than the Chi-square approximation. Hence in this analysis the F statistic is used. In order to test the equality of the stress and calm variance vectors we use the Brown-Forsythe modified Levene test (Brown and Forsythe, 1974). This appears to be a superior test in terms of robustness and power compared to other tests, Conover et al (1981). The test is distributed as an F statistic with G-1 degrees of freedom in the numerator and N-G degrees of freedom in the denominator; where G is the number of groups and N is the number of observations. Finally to test the equality of the mean return vector we use the Q_2 statistic (Morrison, 1976) which follows an F-distribution with p and $N_1 + N_2 - p - 1$ degrees of freedom; where N_1 and N_2 are the number off observation in the calm and stress periods respectively and p is the number of means (p = 5). The null hypothesis being tested in each case is that the two vectors (matrices) are equal. These tests having previously employed by Kryzanowski and To (1987); Kaplanis (1988); Meric and Meric (1989); Tang (1995), and Wahab and Lashgari (1993) to test the inter-temporal stability of the portfolio parameters in international equity markets. The results presented in Table 3.

Table 3: Tests of Difference in Mean, Variance, Covariance and Correlation Matrices in Periods of Financial Stress and Calm

Matrix	F Statistic	P-value
Mean	**18792.31**	**0.000**
Variance	**93.72**	**0.000**
Covariance	**31.31**	**0.000**
Correlation	**0.48**	**0.953**

The Q_2 statistic shows that the stress and calm mean return vectors are significantly different at the usual levels of significance (F = 18792.31, p = 0.000). The Brown-Forsythe test showing that the stress and calm variance vectors are significantly different (F = 93.72, p = 0.000). While the Box M test shows that the stress and calm

[1] See Tang (1995) for more details

period covariance matrices are significantly different (F = 31.31, p = 0.000). In contrast, there is no significant difference between the two correlation matrices (F = 0.478, p = 0.953).

However, the results in Table 3 do not indicate which of the investments are leading to the reject of the null hypothesis of equality between the various statistics in periods of stress and calm. Table 4 shows the results of testing the individual means, variances and correlations to identify the assets causing the changes in values between clam and stress periods. The test of the equality of means is investigated by a t-test, the test of the equality of individual variances examined by the Brown-Forsythe test and the test of the equality of the correlation coefficients is analysed by the methodology used in Shaked (1985). The test statistic used by Shaked (1985) is a Chi-squared test with k-1 degrees of freedom, where k is the number of correlations to be tested (k=2)[2]. Based on the results of the Brown-Forsythe tests the risk for all the assets in the calm and stress periods are all significantly different at better than the 1% level. In contrast, based on the results of t-tests, Table 4 shows that only two of the assets classes show significant differences in mean returns in calm and stress periods, large cap stocks and T-Bills. Table 4 showing that we cannot reject the equality of the mean returns of small cap stocks, bonds and REITs. This implies that in periods of stress there is a universal increase in individual risk by the asset classes that is not match by a change in average returns. Finally, Table 4 shows that only one pair of investments showed significant differences in correlation between the calm and stressful periods, large cap stocks and long-dated government bonds (p = 0.111). This implies that the correlations between the various assets classes measure the degree of integration between markets and that this integration will not change suddenly, whereas the individual risks and returns of asset classes can be subject to sudden changes.

Table 4: Tests of Equality in Individual Means, Variances and Correlations

Test of Difference	LARGE	SMALL	LTGOV	TBILL	RE
Means	2.209	0.963	1.463	6.425	1.307
P-value	0.028	0.336	0.144	0.000	0.192
Variance	74.611	61.759	141.146	55.261	64.199
P-value	0.000	0.000	0.000	0.000	0.000
Correlations	**LARGE**	**SMALL**	**LTGOV**	**TBILL**	**RE**
LARGE	N/a				
SMALL	0.071	N/a			
LGOV	2.542	0.558	N/a		
TBILL	0.011	0.355	0.023	N/a	
RE	1.508	0.979	0.524	0.268	N/a
P-value	**LARGE**	**SMALL**	**LTGOV**	**TBILL**	**RE**
LARGE	N/a				
SMALL	0.790	N/a			
LGOV	0.111	0.455	N/a		
TBILL	0.915	0.551	0.879	N/a	
RE	0.219	0.322	0.469	0.604	N/a

In summary, since the correlation matrix is relatively stable in calm and stress periods whereas the covariance matrix is significantly different and the mean returns of some of the assets are relatively similar in stress and calm periods it is the increase in risk (variance) that will determine the composition of the optimal portfolios. As a

[2] See Snedecor and Cochran (1980) p. 187 for more details.

consequence, those assets with the least risk will dominate the optimal portfolio in periods of stress whereas the assets with the best returns will dominate the optimal portfolios in periods of calm. In other words, bonds and T-bills are likely to be the dominant assets to hold in periods of financial stress, whereas in calmer periods the assets to hold are likely to be large an small cap stocks. But what about real estate, is it an asset for periods of stress or calm?

The Impact of Real Estate

In order to test the effectiveness of real estate in stabilising a mixed-asset portfolio a base-line portfolio was established containing 60% equities (40% Large cap and 20% small cap) and 40% bonds (35% long-dated government bonds and 5% T-bills) and the resultant risk and return of this portfolio calculated for the data overall and for the periods of calm and stress, the results shown in Table 5. To this base-line portfolio a holding in REITs of 5%, 10%, 15% and 20% was added, replacing the same amount in one asset class at a time, and the resultant risk/return performance calculated. The re-allocation of the base-line assets to REITs was done in three ways. First, the holding in REITs replaced the same percentage in large cap stocks. In the second approach the percentage allocated to REITs replaced the same proportion in the long-term government bond holding. Finally, the holding in REITs replaced the equivalent percentage in small cap stocks. In this way the impact of real estate on the mixed-asset portfolio could be evaluated under a number of scenarios.

As shown in Table 5 an investor holding the base-line portfolio, with no holding in REITs, would have shown an annualised return of 11.2% overall, made up of a return in calm periods of 13.1% and a return of 4.5% in periods of financial stress. This return balanced by a risk of 12.3% overall, comprising a risk of 8.9% in the calm periods and 20.8% in the period of stress. But as shown in Table 5 the inclusion of REITs could have improved this risk/return trade off depending on the asset class replaced. For instance, a holding of 20% in REITs replacing an equivalent amount in large cap stocks leads to a fall in return from 11.2% in the base portfolio to 10.7%, a loss in return of 50 basis points. However, this loss in return is more than compensated for by a reduction in risk of 90bp. More importantly, replacing large cap stocks with 20% in REITs leads to an *increase* in return of 70bp and a *reduction* in risk of 170bp in the periods of financial stress. In contrast, when 20% of the mixed-asset portfolio is allocated to REITs at the expense of long-term government bonds there is an increase in return from 11.2% to 11.4%, a gain of 20 basis points, but at the cost of an increase in risk of 130bp. In the period of financial stress the position is even worse with a 20% allocation to REITs leading to a reduction in return of 160bp and an increase in risk of 310bp. The impact of replacing small cap stocks with REITs is different again. A 20% allocation to REITs leading to reductions in return overall and in both sub-periods, however, these reductions in return are matched by greater reductions in risk. Thus, the benefit of including real estate in the mixed-asset portfolio comes from its risk reduction ability rather than any return enhancement depending on the asset class replaced, confirming the finding of Lee (2002). The initial results showing that replacing bonds with REITs is generally detrimental to the performance of the mixed-asset portfolio, however, replacing equities with REITs, especially large cap stocks leads to improvements in portfolio performance when it is most needed, i.e. in periods of financial stress.

Table 5: The Impact of Real Estate on the Mixed-Asset Portfolio: January 1972 to December 2001

	Replacing	Large Cap Stocks				Long-term Government Bonds				Small Cap Stocks			
Weight in Real Estate	**0%**	**5%**	**10%**	**15%**	**20%**	**5%**	**10%**	**15%**	**20%**	**5%**	**10%**	**15%**	**20%**
L. Cap Stock	40	35	30	25	20	40	40	40	40	40	40	40	40
S. Cap Stock	20	20	20	20	20	20	20	20	20	15	10	5	0
Gov Bonds	35	35	35	35	35	30	25	20	15	35	35	35	35
T-Bills	5	5	5	5	5	5	5	5	5	5	5	5	5
Total	100	100	100	100	100	100	100	100	100	100	100	100	100
Overall Mean	11.2	11.1	11.0	10.8	10.7	11.3	11.3	11.3	11.4	11.0	10.7	10.4	10.2
Overall SD	12.3	12.0	11.7	11.5	11.4	12.5	12.9	13.2	13.6	11.8	11.5	11.2	10.9
Calm Mean	13.1	12.9	12.7	12.4	12.2	13.3	13.4	13.6	13.7	12.8	12.6	12.3	12.0
Calm SD	8.9	8.6	8.5	8.3	8.2	9.0	9.1	9.3	9.5	8.5	8.3	8.0	7.8
Stress Mean	4.5	4.7	4.9	5.1	5.2	4.1	3.7	3.3	2.9	4.3	4.0	3.8	3.6
Stress SD	20.8	20.4	19.9	19.6	19.4	21.5	22.2	23.0	23.9	20.1	19.5	19.0	18.6
Gain/Loss Basis Points		% Gain (+) Loss (-)				% Gain (+) Loss (-)				% Gain (+) Loss (-)			
Overall Mean	N/a	-10	-20	-40	-50	10	10	10	20	-20	-50	-80	-100
Overall SD	N/a	-30	-60	-80	-90	20	60	90	130	-50	-80	-110	-140
Calm Mean	N/a	-20	-40	-70	-90	20	30	50	60	-30	-50	-80	-110
Calm SD	N/a	-30	-40	-60	-70	10	20	40	60	-40	-60	-90	-110
Stress Mean	N/a	20	40	60	70	-40	-80	-120	-160	-20	-50	-70	-90
Stress SD	N/a	-40	-90	-120	-140	70	140	220	310	-70	-130	-180	-220

The Impact of Getting it Wrong

It follows that if an investor could correctly identify the coming period he would hold the correct portfolio weights. For instance, if the next period was forecast to be a period of financial stress the results above suggest that the investor should hold greater amounts of bonds and lower amounts of equities. On the other hand, if the next period is predicted to be one of financial calm more would be allocated to equities and less to bonds. Unfortunately investors face the prospect of getting it wrong, that is holding the weights in anticipation of a period of stress when in fact a period of calm actually occurs and visa versa. We now check the initially results by constructing two new base-line portfolios one based on the assumption that all periods are classified as periods of calm and the other based on the assumption that all periods were ones of financial stress. Consequently, the calm period portfolio should contain a larger allocation to equities and a corresponding lower allocation to bonds. The stress period portfolios should have a greater holding in bonds and a lower allocation to equities. In this way the consequences of holdings in REITs on portfolio performance when the investor is holding the wrong asset mix can be evaluated. The results presented in Tables 6 and 7.

The base weights of the calm and stress assumption portfolios are as follows:

Calm: 55% Large Cap, 25% Small Cap, 15% Long-dated Gov, and 5% T-bills
Stress: 30% Large Cap, 10% Small Cap, 55% Long-dated Gov, and 5% T-bills

Calm Weights

If an investor, with no holding in REITs, always held the calm weights, i.e. over weighed equities, he would have shown an annualised return of 12.0%. This overall performance made up of a return in calm periods of 14.7% and a return of 2.6% in periods of financial stress. The risk of holding the clam period weights was 15.0% overall, made up of a risk of 10.5% in the calm period and 26.1% in the period of stress. But as shown in Table 6 the inclusion of REITs could have improved this risk/return trade off depending on the asset class replaced. For instance, replacing large caps stocks with REITs would have led to a reduction in return of up to 56p, when the holding in REITs was 20%. This reduction in return, however, is concentrated in the calm period. In the period of financial stress replacing large cap stock with a 20% allocation to REITs would have increased return by 72bp. In addition, any reduction in return, from holding REITs would have been more than compensated for by the reduction in portfolio risk, especially in the stress period. In contrast, replacing bonds with REITs would have led to an increase in return of up to 22bp overall, but this time the increase is concentrated in the calm periods. In addition replacing bonds with REITs would have led to an increase in risk, especially in the stress periods. Replacing small cap stocks with REITs and assuming calm weights would have led to reductions in return overall and in both sub-periods. However, the reduction in return is more than compensated for by reductions in risk, especially in stress periods when a 20% allocation to REITs risk would have led to a 282bp reduction in risk for a loss of only 92bp in return. In other words, including real estate in the mixed-asset portfolio leads to reduction in risk in both calm and stress periods if the allocation to large and small cap stocks is reduced.

Stress Weights

An investor who held the stress weights, i.e. under weighted equities, would have shown an average return of 10.3% overall, made up of a return of 11.5% in the period of calm and 6.0% in the periods of stress. The risk of holding the stress period weights was 10.3% overall, made up of a risk of 7.7% in the calm period and 16.9% in the period of stress. But as shown in Table 7 the inclusion of REITs would have led to an increase or decrease in return overall, compared with the base line portfolio, depending on the asset class replaced. For instance, replacing large cap stocks by an allocation of 20% to REITs would have seen return fall by 55bp, on average, but with the risk falling by 64bp. The greatest reduction in return occurring in the periods of calm of 91bp but with a fall in risk of 51bp, while the periods of stress would have shown an increase in return of 74bp and a fall in risk of 99bp. In contrast, replacing bonds with REITs would have led to a marginal increase in return of only 11bp overall. However, this increase in return is concentrated in the calm periods where return increased by 58bp. In contrast, the periods of financial stress would have shown large reductions in return of 159bp. More importantly replacing bonds by REITs would have increases risk overall but especially in the periods of financial stress. Replacing small cap stocks with REITs and assuming stress period weights would have led to reductions in return overall, but especially in the periods of calm rather than the periods of financial stress. More importantly, the reduction in return are more than compensated for by reductions in risk, especially in the periods of financial stress when a 20% allocation to REITs risk would have led to a 126bp reduction in risk for a loss of only 10bp in return. In other words, even when the investor gets it right and holds the stress period weights in periods of stress adding real estate to the mixed-asset portfolio can still reduce risk if large or small cap stocks are replaced.

The result of stress testing the initial base-line portfolio confirms the previous findings that replacing bonds with REITs is generally detrimental to the performance of the mixed-asset portfolio especially in periods of stress. However, replacing equities with REITs, especially large cap stocks leads to improvements in portfolio performance when it is most needed, i.e. in periods of financial turmoil.

Table 6: The Impact of Real Estate on the Mixed-Asset Portfolio when Using Calm Weights

Assuming Calm	Replacing	Large Cap Stocks				Long-term Government Bonds				Small Cap Stocks			
Weight in Real Estate	0%	5%	10%	15%	20%	5%	10%	15%	20%	5%	10%	15%	20%
Large Cap Stock	55	50	45	40	35	55	55	55	55	55	55	55	55
Small Cap Stock	25	25	25	25	25	25	25	25	25	20	15	10	5
Gov Bonds	15	15	15	15	15	10	5	0	0	15	15	15	15
T-Bills	5	5	5	5	5	5	5	5	0	5	5	5	5
Total	100	100	100	100	100	100	100	100	100	100	100	100	100
Overall Mean	12.0	11.9	11.8	11.6	11.5	12.1	12.1	12.1	12.3	11.8	11.5	11.2	11.0
Overall SD	15.0	14.6	14.3	14.1	13.9	15.3	15.7	16.2	16.8	14.5	14.0	13.6	13.3
Calm Mean	14.7	14.5	14.2	14.0	13.8	14.8	15.0	15.1	15.4	14.4	14.1	13.9	13.6
Calm SD	10.5	10.2	10.0	9.8	9.7	10.6	10.8	11.0	11.4	10.1	9.7	9.4	9.1
Stress Mean	2.6	2.8	3.0	3.2	3.4	2.2	1.9	1.5	1.2	2.4	2.2	1.9	1.7
Stress SD	26.1	25.5	25.0	24.6	24.2	26.9	27.8	28.7	29.9	25.3	24.5	23.9	23.3
Gain/Loss Basis Points		Gain (+) Loss (-)				Gain (+) Loss (-)				Gain (+) Loss (-)			
Overall Mean	N/a	-14	-28	-42	-56	3	5	8	22	-27	-54	-81	-108
Overall SD	N/a	-33	-63	-88	-109	37	77	122	184	-49	-94	-134	-169
Calm Mean	N/a	-24	-47	-70	-94	15	30	45	73	-28	-57	-85	-113
Calm SD	N/a	-25	-47	-65	-80	16	36	58	98	-38	-73	-104	-131
Stress Mean	N/a	18	36	54	72	-39	-77	-116	-147	-23	-46	-69	-92
Stress SD	N/a	-57	-107	-149	-185	81	168	263	381	-82	-156	-223	-282

Table 7: The Impact of Real Estate on the Mixed-Asset Portfolio when Using Stress Weights

Assuming Stress	Replacing	Large Cap Stocks				Long-term Government Bonds				Small Cap Stocks			
Weight in Real Estate	0%	5%	10%	15%	20%	5%	10%	15%	20%	5%	10%	15%	20%
Large Cap Stock	30	25	20	15	10	30	30	30	30	30	30	25	20
Small Cap Stock	10	10	10	10	10	10	10	10	10	5	0	0	0
Gov Bonds	55	55	55	55	55	50	45	40	35	55	55	55	55
T-Bills	5	5	5	5	5	5	5	5	5	5	5	5	5
Total	100	100	100	100	100	100	100	100	100	100	100	100	100
Overall Mean	10.3	10.2	10.1	9.9	9.8	10.4	10.4	10.4	10.4	10.1	9.8	9.7	9.5
Overall SD	10.3	10.0	9.8	9.7	9.6	10.3	10.5	10.7	11.0	10.0	9.8	9.6	9.5
Calm Mean	11.5	11.3	11.1	10.8	10.6	11.7	11.8	12.0	12.1	11.2	11.0	10.7	10.5
Calm SD	7.7	7.5	7.4	7.3	7.2	7.7	7.7	7.8	7.9	7.5	7.3	7.2	7.1
Stress Mean	6.0	6.2	6.4	6.6	6.7	5.6	5.2	4.8	4.4	5.8	5.5	5.7	5.9
Stress SD	16.9	16.5	16.2	16.0	15.9	17.2	17.6	18.2	18.8	16.4	16.1	15.8	15.6
Gain/Loss		Gain (+) Loss (-)				Gain (+) Loss (-)				Gain (+) Loss (-)			
Overall Mean	N/a	-14	-28	-41	-55	3	5	8	11	-27	-53	-67	-81
Overall SD	N/a	-25	-45	-57	-64	10	26	49	78	-27	-48	-66	-78
Calm Mean	N/a	-23	-46	-69	-91	15	29	44	58	-28	-55	-78	-101
Calm SD	N/a	-19	-34	-45	-51	-1	2	10	22	-21	-37	-51	-60
Stress Mean	N/a	19	37	56	74	-40	-80	-119	-159	-24	-47	-29	-10
Stress SD	N/a	-41	-71	-91	-99	31	74	129	194	-45	-78	-108	-126

Conclusions

The case for holding real estate in the mixed-asset portfolio is typically made on its stabilising effect as a result of its diversification benefits. However, portfolio diversification often fails when it is most needed, i.e. during periods of financial stress. In these periods, the variability of returns for most asset classes increases thus reducing the stabilising effect of a diversified portfolio. This paper applies the approach of Chow et al (1999) to the US domestic mixed-asset portfolio to establish whether real estate, represented by REITs, is especially useful in times of financial stress. To this end monthly returns data of five assets classes: large cap stocks, small cap stocks, long dated government bonds, cash (T-Bills) and real estate (REITs) is analysed over the period January 1972 to December 2001.

Using a base-line portfolio containing 60% in equities and 40% in bonds the risk/return performance of REITs in the mixed-asset portfolio was examined under a number of scenarios. The results indicate that the inclusion of REITs in the mixed-asset portfolio can lead to increases or decreases in average returns depending on the asset class replaced, confirming the findings Lee (2002). However, the inclusion of REITs invariably leads to reductions in portfolio risk that are greater than any loss in return, especially in periods of financial stress.

These initially results were then stress tested by constructing two new base-line portfolios: one based on the assumption that all periods could be classified as calm and the other based on the assumption that all periods were ones of financial stress. The calm period portfolios containing a larger allocation to equities and a corresponding lower allocation to bonds, the stress period portfolios having a greater holding in bonds and a lower allocation to equities. In this way the consequences of holdings in REITs on portfolio performance could be evaluated when the investor always got it wrong. Once again the results support the previous findings with the allocation to REITs either increasing or decreasing returns, depending on the asset replaced. However, holdings in REITs almost always led to reductions in risk, especially in periods of financial turmoil.

The results showing that if real estate is to be included in the mixed-asset portfolio replacing bonds with REITs is generally detrimental to performance, especially in periods of stress. However, replacing equities with REITs, especially large cap stocks, generally leads to improvements in portfolio performance when it is most needed, i.e. in periods of financial stress.

References

Benari, Y (1990) Optimal Asset Mix and its Link to Changing Fundamental Factors, *Journal of Portfolio Management*, 11-18

Black, F. and Litterman, R. (1992) Global Portfolio Optimization. *Financial Analysts Journal*, Oct, 28-43

Box, G. (1949) A General Distribution Theory for a Class of Likelihood Criteria, *Biometrika*, 317-346

Brown, M.B. and Forsythe, A.B. (1974) Robust Tests for the Equality of Variances, *Journal of the American Statistical Association*, 69, 364-367.

Cheung, Y.L. and Ho, Y.K. (1991) The Intertemporal Stability of the Relationships between the Asian Emerging Equity Markets and the Developed Markets, *Journal Business Finance and Accounting*, **18**, 235-54.

Clarke, R.G. and de Silva, H. (1998) State-Dependent Asset Allocation, *Journal of Portfolio Management*, Winter, 57-64

Conover, W.J., Johnson, M.E. and Johnson, M.M. (1981) A Comparative Study of Tests of Homogeneity of Variances with Applications to the Outer Continental Shelf Bidding Data, *Technometrics*, **23**, 351-361.

Farrell, J.L. Jr. (19890 A Fundamental Forecast Approach to Superior Asset Allocation, *Financial Analysts Journal*, May-June, 32-37

Geltner, D.M. (1993) Estimating Market Values from Appraised Values without Assuming an Efficient Market, *Journal of Real Estate Research*, **8**, 325-345.

Clascock, J.L., Lu, C. and So, R.W. (2000) Further Evidence on the Integration of REIT, Bond, and Stock Returns, *Journal of Real estate Finance and Economics*, **20**, p1-9

Hansen, L.P. and Jagannathan, R. (1991) Implications of Security Market Data for Models of Dynamic Economics, *Journal of Political Economy*, **99**, 225-261.

Harrison, M. (1992) A New Structure for Managing Investments, *Public Finance and Accountancy*, 20 March, 20-21.

Ibbotson Associates (2002) *Stocks, Bonds, Bills and Inflation, 2002 Yearbook*, Ibbotson Associates Inc

Jorion, P. (1985) International Portfolio Diversification with Estimation Risk, *Journal of Business*, July, 259-278

Kaplanis, E.C. (1988) Stability and Forecasting of the Co-movement Measures of International Stock Market Returns, *Journal of International Money and Finance*, **7**, 63-75.

Kryzanowski, L. and To, M.C. (1987) The E-V Stationarity of Security Returns: Some Empirical Evidence, *Journal of Banking and Finance*, **11**, 117-35.

Kuhle, J. (1987) Portfolio Diversification and Return benefit – Common Stocks Vs. Real Estate Investment Trusts (REITs), *The Journal of Real Estate Research*, **2**, 1-9

Lee, S.L. (2002) *Is There a "Case for Property" All the Time?* A Paper Presented at the European Real Estate Society (ERES) Meeting Glasgow June

Liang, Y and McIntosh, W. (1998) REIT Style and Performance, *Journal of Real Estate Portfolio Management*, **4**, 69-78

Marmer, H. (1991) Optimal International Asset Allocation Under Different Economic Environments: A Canadian Perspective, *Financial Analysts Journal*, November-December, 85-91

Meric, L. and Meric, G. (1989) Potential Gains from International Portfolio Diversification and Intertemporal Stability and Seasonality in International Stock Market Relationships, *Journal of Banking and Finance*, **13**, 627-40

Muller, G.R., Pauley, K.R. and Morrill, W.K.Jr (1994) Should REITs be Included in a Mixed-asset Portfolio? *Real Estate Finance*, **11**, 23-28

NAREIT (2002) *Diversification Benefits of REITs - An Analysis by Ibbotson Associates*, html//www.nareit.com

Pearson, E.S. (1969) Some Comments on the Accuracy of Box's Approximations to the Distribution of M, *Biometrika*, **56**, 219-220.

Sa-Aadu, J., Shilling, J.D. and Tiwari, A. (2001) *The Persistence and Timing of Portfolio Diversification Gains across Different Asset Classes*, Presented at the Sixth Annual Asian Real Estate Society (AsRES) Meeting, August

Shaked, I. (1985) International Equity Markets and the Investment Horizon, *Journal o Portfolio Management*, Winter, 80-84

Snedecor, G.E. and Cochran, W.G. (1980) *Statistical Methods*, Iowa State University Press

Tang, G.Y.N. (1995) Stability of International Stock Market Relationships Across Month of the Year and Different Holding Intervals, *European Journal of Finance*, **1**, 207-218.

Wahab, M. and Lashgari, M. (1993) Covariance Stationarity of International Equity Market Returns: Recent Evidence, *The Financial Review*, **28**, 239-60.